

**UTILITY PATENT APPLICATION TRANSMITTAL
(Small Entity)***(Only for new nonprovisional applications under 37 CFR 1.53(b))*Docket No.
47513

Total Pages in this Submission

TO THE ASSISTANT COMMISSIONER FOR PATENTS**Box Patent Application
Washington, D.C. 20231**

Transmitted herewith for filing under 35 U.S.C. 111(a) and 37 C.F.R. 1.53(b) is a new utility patent application for an invention entitled:

METHODS FOR REFLECTION REDUCTIONS

and invented by:

Peter W. J. JONESIf a **CONTINUATION APPLICATION**, check appropriate box and supply the requisite information:☒ **Continuation** ☐ **Divisional** ☐ **Continuation-in-part (CIP)** of prior application No.: 60/048,998

Which is a:

☐ **Continuation** ☐ **Divisional** ☐ **Continuation-in-part (CIP)** of prior application No.: _____

Which is a:

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Enclosed are:

Application Elements

1. ☒ Filing fee as calculated and transmitted as described below
2. ☒ Specification having 10 pages and including the following:
 - a. ☒ Descriptive Title of the Invention
 - b. ☐ Cross References to Related Applications (*if applicable*)
 - c. ☐ Statement Regarding Federally-sponsored Research/Development (*if applicable*)
 - d. ☐ Reference to Microfiche Appendix (*if applicable*)
 - e. ☒ Background of the Invention
 - f. ☒ Brief Summary of the Invention
 - g. ☒ Brief Description of the Drawings (*if drawings filed*)
 - h. ☒ Detailed Description
 - i. ☒ Claim(s) as Classified Below
 - j. ☒ Abstract of the Disclosure

UTILITY PATENT APPLICATION TRANSMITTAL (Small Entity)

(Only for new nonprovisional applications under 37 CFR 1.53(b))

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Application Elements (Continued)

3. ☒ Drawing(s) (when necessary as prescribed by 35 USC 113)
- a. ☒ Formal b. ☐ Informal Number of Sheets 8
4. ☒ Oath or Declaration
- a. ☒ Newly executed (original or copy) ☐ Unexecuted
- b. ☐ Copy from a prior application (37 CFR 1.63(d)) (for continuation/divisional application only)
- c. ☒ With Power of Attorney ☐ Without Power of Attorney
- d. ☐ DELETION OF INVENTOR(S)
Signed statement attached deleting inventor(s) named in the prior application,
see 37 C.F.R. 1.63(d)(2) and 1.33(b).
5. ☒ Incorporation By Reference (usable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under
Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby
incorporated by reference therein.
6. ☐ Computer Program in Microfiche
7. ☐ Genetic Sequence Submission (if applicable, all must be included)
- a. ☐ Paper Copy
- b. ☐ Computer Readable Copy
- c. ☐ Statement Verifying Identical Paper and Computer Readable Copy

Accompanying Application Parts

8. ☒ Assignment Papers (cover sheet & documents)
9. ☐ 37 CFR 3.73(b) Statement (when there is an assignee)
10. ☐ English Translation Document (if applicable)
11. ☐ Information Disclosure Statement/PTO-1449 ☐ Copies of IDS Citations
12. ☐ Preliminary Amendment
13. ☒ Acknowledgment postcard
14. ☒ Certificate of Mailing
- ☐ First Class ☒ Express Mail (Specify Label No.): TB553892867US

UTILITY PATENT APPLICATION TRANSMITTAL (Small Entity)

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Docket No.
47513

Total Pages in this Submission

Accompanying Application Parts (Continued)

15. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed)
16. ☒ Small Entity Statement(s) - Specify Number of Statements Submitted: 1
17. ☐ Additional Enclosures (please identify below):

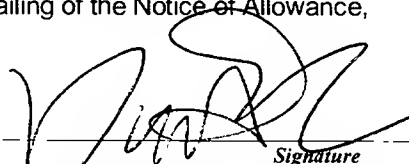
Fee Calculation and Transmittal

CLAIMS AS FILED

For	#Filed	#Allowed	#Extra	Rate	Fee
Total Claims	9	- 20 =	0	x \$11.00	\$0.00
Indep. Claims	2	- 3 =	0	x \$41.00	\$0.00
Multiple Dependent Claims (check if applicable) <input type="checkbox"/>					\$0.00
BASIC FEE					\$395.00
OTHER FEE (specify purpose) <u>Assignment Recordal</u>					\$40.00
TOTAL FILING FEE					\$435.00

- ☒ A check in the amount of **\$395.00** to cover the filing fee is enclosed.
- ☒ The Commissioner is hereby authorized to charge and credit Deposit Account No. **04-1105** as described below. A duplicate copy of this sheet is enclosed.
- ☐ Charge the amount of _____ as filing fee.
 - ☒ Credit any overpayment.
 - ☒ Charge any additional filing fees required under 37 C.F.R. 1.16 and 1.17.
 - ☐ Charge the issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance, pursuant to 37 C.F.R. 1.311(b).

Dated: June 9, 1998


Signature

Peter F. Corless (Reg. No. 33,860)
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CERTIFICATE OF MAILING BY "EXPRESS MAIL" (37 CFR 1.10)Applicant(s): **Peter W. J. JONES**

Docket No.

47513

Serial No.

Not Yet Assigned

Filing Date

Herewith

Examiner

Not Yet Assigned

Group Art Unit

Not Yet Assigned

Invention: **METHODS FOR REFLECTION REDUCTIONS**

Utility Patent Application Transmittal (3 pages); New Patent Application (7 pages of specification, 2 pages of claims, 1 page of abstract and 8 sheets of drawings); Executed Declaration and Power of Attorney Form;

I hereby certify that this **Assignment Recordal; Executed Assignment; Small Entity Status Form;**
Check in the amount of *(Identify type of correspondence)*
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is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under

37 CFR 1.10 in an envelope addressed to: The Assistant Commissioner for Patents, Washington, D.C. 20231 on

June 9, 1998

(Date)

Peter F. Corless

(Typed or Printed Name of Person Mailing Correspondence)

(Signature of Person Mailing Correspondence)

TB553892867US

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Note: Each paper must have its own certificate of mailing.

METHODS FOR REFLECTION REDUCTIONS

RELATED APPLICATION

The present application claims the benefit of U.S. Provisional Application No. 60/048,998 filed June 9, 1997, which is fully incorporated herein by
5 reference.

FIELD OF THE INVENTION

This invention relates generally to minimization of reflections from surfaces, and more specifically reflections from objective lenses or other
10 reflective surfaces of wide-angle field of view optical devices.

BACKGROUND OF THE INVENTION

Reflections from the objective lens or other reflective surfaces of an optical system (glint) have long been a problem, especially in a battlefield
15 environment. These reflections turn out to also be a problem with wide-angle field-of-view (FOV) optics such as night vision goggles. This is especially so when operating in an environment where relatively bright ambient sources such as street lights are present, or in situations where the enemy also has night vision equipment and thus can see reflections of moon or starlight from an
20 objective lens or reflective filter.

An existing method of reducing or eliminating such reflections is to put a honeycomb grid of tubes in front of the objective lens (as is described in U.S. Patent #4,929,055, which is fully incorporated herein by reference). The tubes
25 in these devices have walls that are parallel to the optical axis of the device to which it is fitted.

This technique, however, is not an effective solution with wide angle FOV devices, since if the length-to-width ratio of the tubes which make up the honeycomb of parallel-walled tubes is shallow enough not to vignette the view through the optic, then the tubes are not deep enough to give affective glint protection. This means that in a battlefield situation, wide-angle FOV optical devices are vulnerable to being detected by an envoy, and thus dangerous to use.

Accordingly, it is highly desirable, if not necessary, to devise other techniques for substantially preventing reflections from the reflecting surfaces of wide-angle FOV optical devices.

As can be seen in FIG.1, a reflective element 1 of an optical device 2 can reflect light rays 5 from a light source 3 to an observer 4. The Observer 4 includes sophisticated light detection systems possibly operating in the infrared and ultraviolet spectrums as well as human or animal observers.

An existing method of hiding such reflections is shown in FIG 2. where a honeycomb of parallel-walled tubes 6 is placed in front of the optical device 2. The walls of the tubes are parallel to the optical axis of the device to which it is fitted. This collection of tubes 6 prevents light from a source 3 from reflecting to an observer 4.

As shown in FIG. 3, the length-to-width ratio of the tubes 12 that make up the honeycomb cannot exceed the length-to-width ratio of the FOV 13 of the optical device to which it is fitted. In this way, the anti-reflection shield does not restrict field of view seen through the optical device.

As shown in FIG 4, an example of this would be the U.S. Army's PVS-7 night vision goggles, which have a FOV 13 of 40°. If one were to use the existing method of reflection protection, the length-to-width ratio of the deepest (longest)

tubes 6 that could be used in a conventional anti-reflection shield are 1:1.38. This is not deep enough to give good glint protection. If deeper tubes are used, they would intrude on the FOV and vignette the image seen through the device, as illustrated in Fig. 5.

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The problem has been how to get tubes long enough to provide effective glint protection without vignetting the view through the optic.

SUMMARY

10 It is an objective of the present invention to provide reflection and glint protection while allowing a wide field of view (FOV) for surfaces including optical lenses.

15 The present invention includes an apparatus for reducing reflection on a surface including a plurality of concentric circular vanes, each of the vanes including a first end proximate the surface. The second end of the plurality of vanes is away from the surface. The first ends of the plurality of vanes are positioned closer together to each other than said second ends of said plurality of vanes.

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This surface includes optical lenses, wide FOV lenses, binoculars, telescopes, gun sights and night vision goggles.

25 In another embodiment, the first ends of the plurality of vanes are positioned further apart from each other than the second ends of the plurality of vanes.

In another embodiment, a plurality of radial vanes are interconnected with the plurality of concentric circular vanes.

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The present invention includes a system and method for reducing reflection from a surface of an optical lens comprising vane means for limiting reflections from said surface while maintaining a substantially wide Field of View (FOV) for said optical lens. The vane means is for mounting proximate a surface of the optical lens.

DESCRIPTION OF THE DRAWINGS

The foregoing and other features and advantages of the present invention will be more fully understood from the following detailed description of illustrative embodiments, taken in conjunction with the accompanying drawings in which:

Fig. 1 is an overview of a reflection problem;

Fig. 2 is an overview of prior attempt to correct a reflection problem;

Fig. 3 provides details of the Field of View (FOV) of Fig. 2;

Fig. 4 provides details of FOV angles;

Fig. 5 provides details of FOV angles;

Fig. 6 illustrates an embodiment of the present invention;

Fig. 7 details FOV angles for the embodiment illustrated in Fig. 6;

Fig. 8 and 9 illustrate details of optical image forming by convex lenses;

Fig. 10 illustrates a further embodiment of the present invention;

Fig. 11 details FOV angles for the embodiment illustrated in Fig. 10;

Fig. 12 illustrates a further embodiment of the present invention;

Fig. 13 illustrates a further embodiment of the present invention;

Fig. 14 illustrates yet another embodiment of the present invention; and

Fig. 15 illustrates yet another embodiment of the present invention.

DETAILED DESCRIPTION

In the novel technique, shown in one embodiment in FIG. 6, we describe a shield made up of deep tubes 32, the walls of which are not parallel, which is placed in front of a wide-angle FOV optic 33.

As shown in FIG. 7, this would seem to give a structure 32 that would vignette the FOV 13 seen through a wide-angle FOV optic 33; this actually is not the case.

5

As shown in FIG. 8, unlike the common explanation found in physics text books of how a lens forms an image, where this is shown by a drawing where a point 40 on the top of a lens 41 forms the image 42 of the top of the subject 43, such as a candle, and the point 45 at the bottom of the lens forms the image 47 of the bottom of the subject 48, what actually happens is shown in FIG. 9, where each point on the lens, as shown with point 51, forms the image 54 of the entire subject 53.

10

With this in mind, we describe a technique for protecting wide angle FOV optics from glint as shown in FIG. 10, wherein we arrange the cell walls 60 that make up the tubes of the antireflection shield such that the walls are parallel to the varying view angles 61 contained within the optic's FOV.

15

As shown in FIG. 11, while in such an arrangement a tube wall 66 would block a point 62 at the top of the lens from seeing on a viewing angle 65 downwards to the bottom part of its normal FOV, there is a point 67 at the bottom of the lens that would have an unobstructed view on the view angle 65 through the tube formed by wall 68. Thus with this new arrangement of tubes, the optical system will, in total, be able to maintain its full FOV in order to form a complete image, and the tubes in the shield can be made long enough to give effective glint protection.

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These tubes can be arranged in various manners. For example, in a section through one embodiment of such a shield as shown in FIG. 12, the walls 60 could be arranged to form concentric tubes that have a conical section. These conical sections would be arranged so that their wall angles gradually

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splayed to accommodate the range of viewing angles contained or thin the wide-angle FOV 71 of the optical device to be protected 33.

Alternatively, as shown in a section through another embodiment of such a shield in FIG. 13, the tube walls 60 could simply have one fixed angle and then be nested concentrically. The wall angles would be selected be related relation to the angle of the FOV of the optic that is to be protected 33. The center conical tube 77 would provide the clear sight lines to the center of the optic's FOV.

As shown in FIG. 14 in a section through yet another embodiment of such a shield, the walls that form the tubes 60 could splay inwards, rather than outwards.

As shown in a front view in FIG. 15, to increase the glint masking ability of this new configuration of an anti-reflection shield, radial vanes 83 can be inserted between the concentric tubes 60 in a manner.

This new technique of using non-parallel tube walls will give critical protection to wide-angle FOV optics on the battlefield.

Note that with this configuration, most points on the surface of the objective lens will have some of their lines of view blocked. This may cause a greater light loss than with the light loss from the earlier method of using a honeycomb of parallel-walled tubes. However, the increased light loss would be acceptable in many battlefield situations if this improved shield keeps the user of the optical device from being detected by the enemy because of reflections.

Further, with respect to the inwardly converging tubular elements as exemplified in FIG. 14, that tubular element configuration can provide the significant advantage of reducing reflections from a lens substrate that is

significantly curved. That is, the inwardly converging tubular elements can effectively capture reflections from such a curved lens surface.

Suitable tubular elements for use in accordance with the present
5 invention are disclosed in U.S. Patent No. 4,929,055 and PCT/US93/11459,
which are both fully incorporated herein by reference.

As various changes could be made in the above constructions without
departing from the scope of the invention, it should be understood that all
10 matter contained in the above description or shown in the accompanying
drawings shall be interpreted as illustrative and not in a limiting sense.

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What is claimed is:

1. An apparatus for reducing reflection on a surface comprising:
a plurality of concentric circular vanes, each of said vanes including a first end proximate said surface, and a second end away from said surface, wherein said first ends of said plurality of vanes are positioned closer together to each other than said second ends of said plurality of vanes.
2. The apparatus of claim 1 wherein said surface is a optical lens.
3. The apparatus of claim 1 wherein said surface is a wide Field of View (FOV) lens.
4. The apparatus of claim 1 wherein said apparatus is configured to be mounted on field goggles.
5. The apparatus of claim 4 wherein said field goggles include night-vision goggles.
6. The apparatus of claim 1 wherein said first ends of said plurality of vanes are positioned further apart from each other than said second ends of said plurality of vanes.
7. The apparatus of claim 1 further including:
a plurality of radial vanes interconnected with said plurality of concentric circular vanes.
8. A system for reducing reflection from a surface of an optical lens comprising:

vane means for limiting reflections from said surface while maintaining a substantially wide Field of View (FOV) for said optical lens; said vane means for mounting proximate said surface of said optical lens.

9. The system of claim 8 wherein said vain means is mounted on field goggles.

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ABSTRACT

System and method for limiting reflections off of surfaces, such as optical lens and field goggles. A set of vanes are mounted next to the surface, with one end near the surface and the other end away from the surface. The vanes are mounted closer together at their end near the surface. This permits a wide field of view (FOV) for surfaces such as optical lenses. The vanes can be arranged in various forms, including concentric rings.

SECRET

FIG. 1

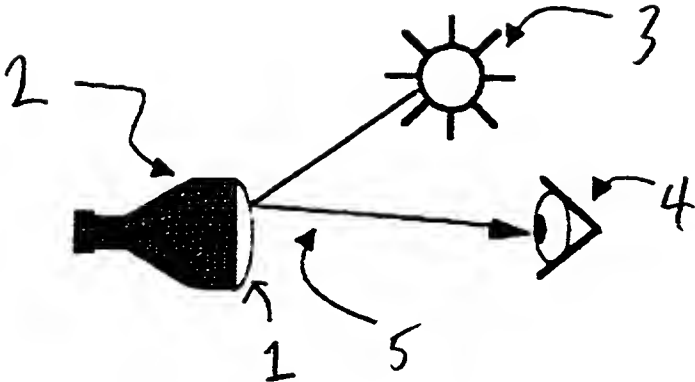
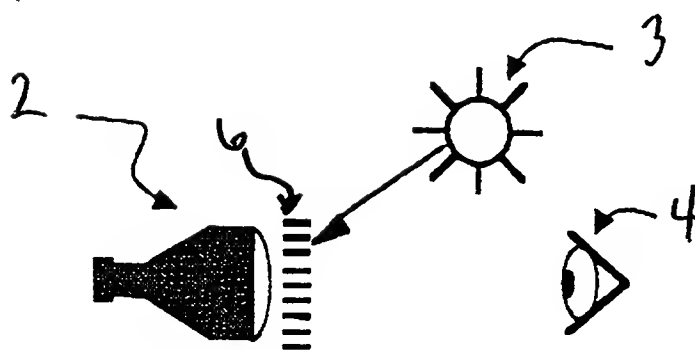


FIG. 2



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FIG. 3

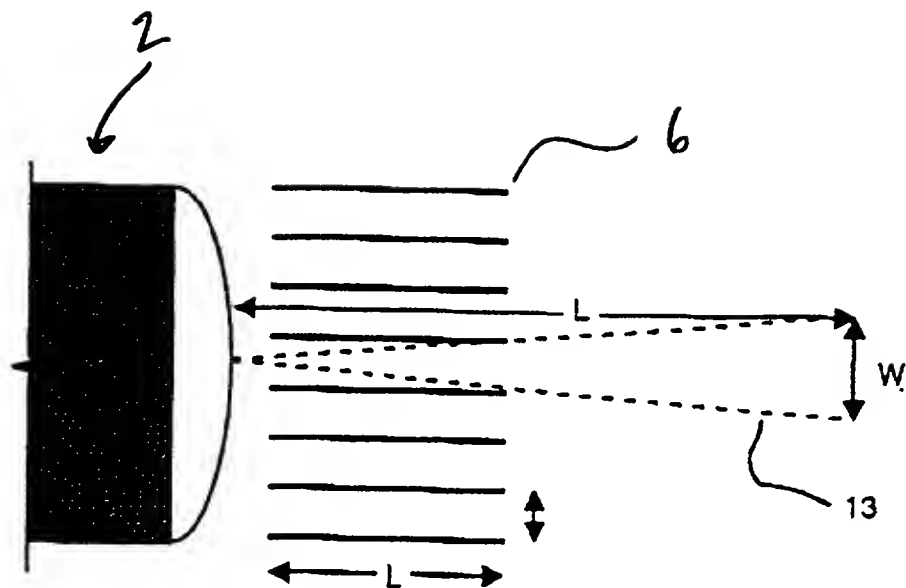


FIG. 4

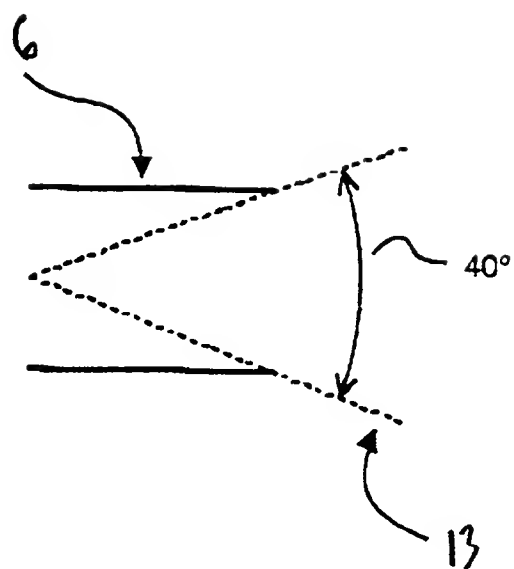


FIG. 5

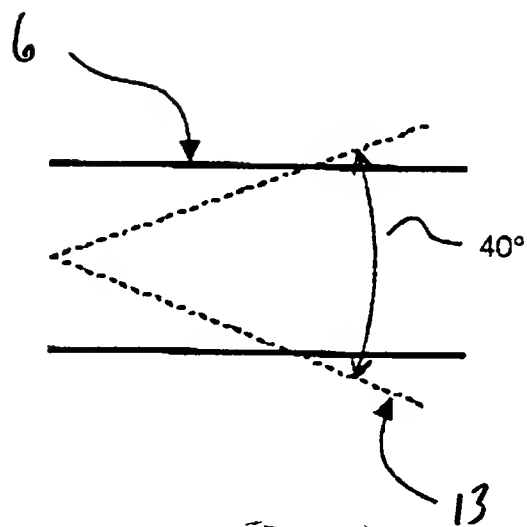


FIG. 6

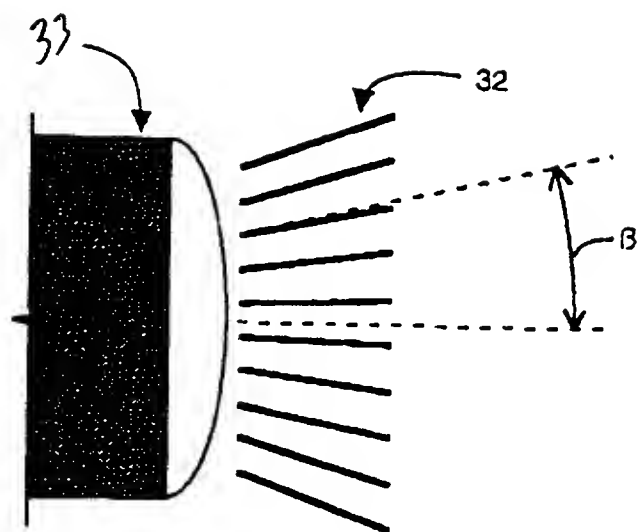


FIG. 7

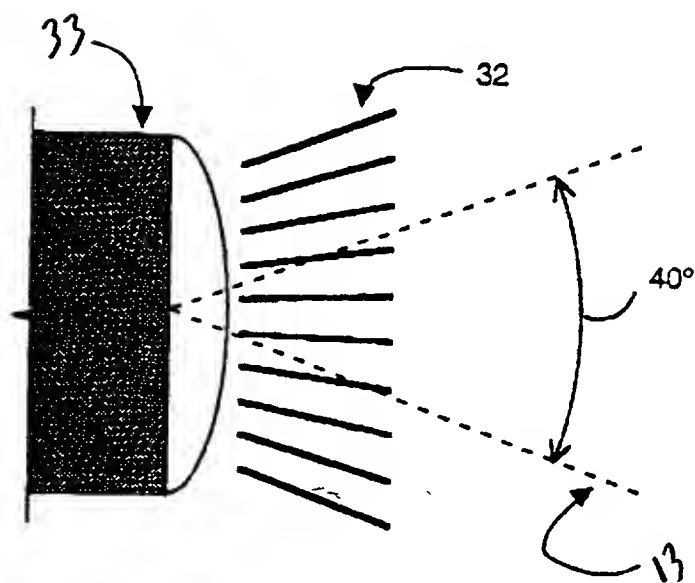


FIG. 8

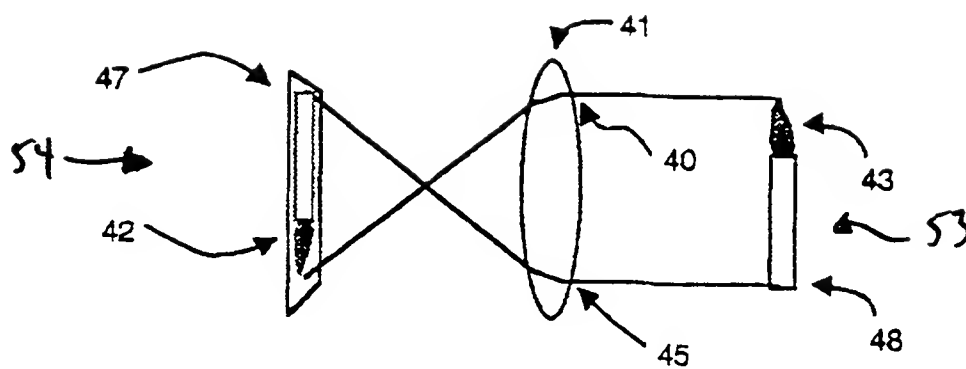


FIG. 9

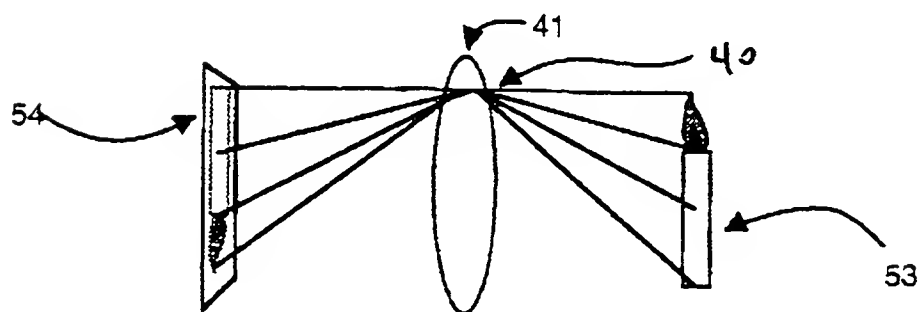


FIG. 10

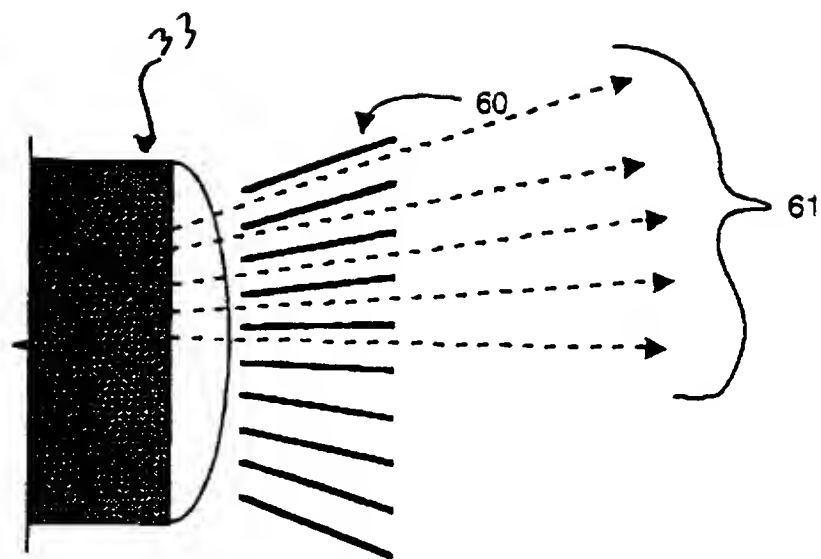


FIG. 11

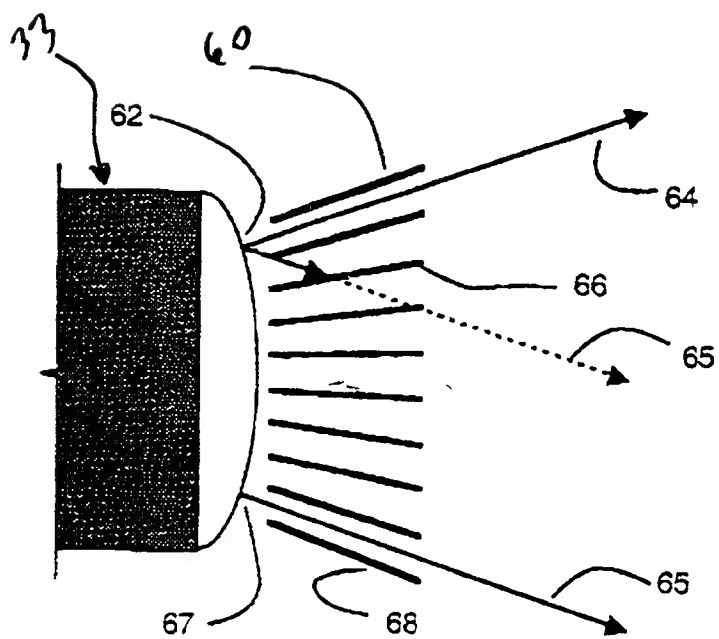


FIG. 12

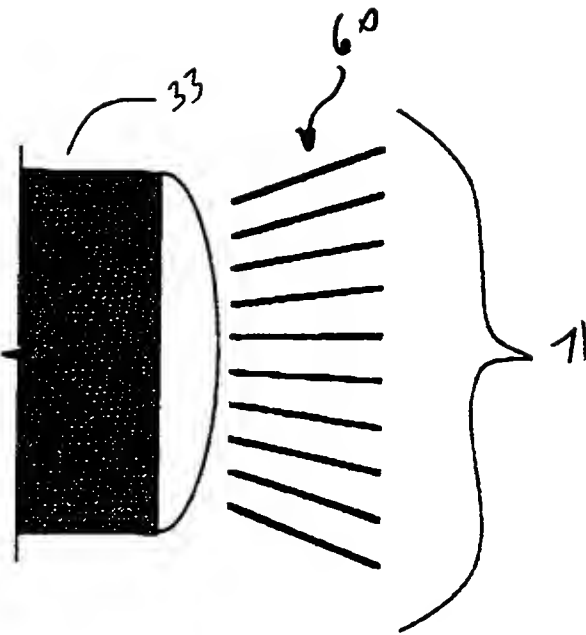


FIG. 13

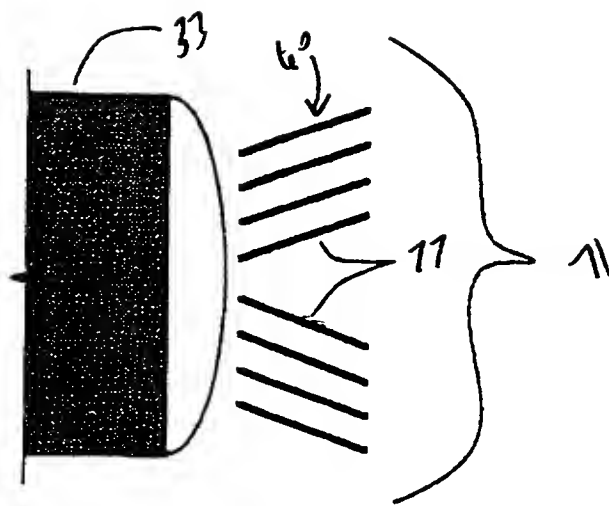


FIG 14

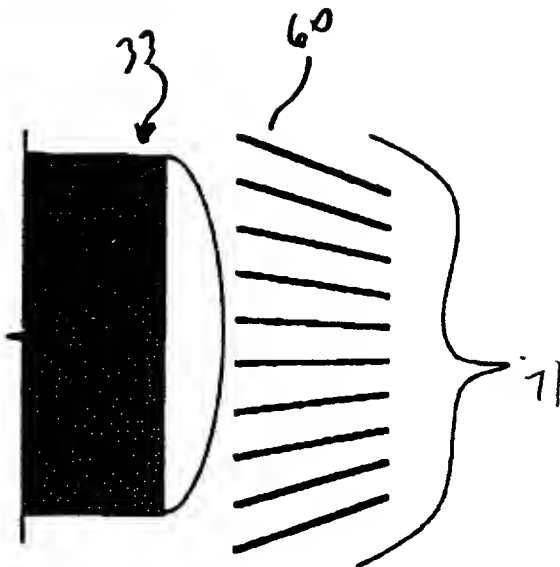
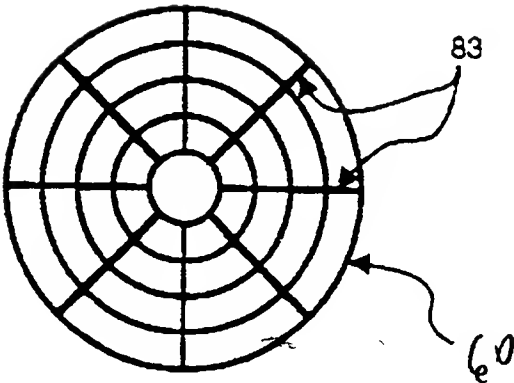


FIG 15



-1-

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Attorney's Docket No. 47513 (1106)

Page 1 of 3

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that: My residence, post office address and citizenship are as stated below next to my name. I believe I am the original, first and sole inventor (if only one name is listed at 201) below or an original, first and joint inventor (if plural names are listed at 201-208 below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHODS FOR REFLECTION REDUCTIONS

which is described and claimed in:

☒ the specification attached hereto.☐ the specification in U.S. Application Serial Number _____, filed on _____

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a). I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

Prior Foreign/PCT Applications and Any Priority Claims Under 35 U.S.C. 119:			
Application No.	Filing Date	Country	Priority Claimed Under 35 U.S.C. 119?
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO

CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S)
(35 U.S.C. § 119(e))

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below:

Applicant	Provisional Application Number	Filing Date
Jones	60/048,998	6/9/97

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) with full powers of

-2-

association, substitution and revocation to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

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		Belmont	MASSACHUSETTS	USA
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE OR COUNTRY AND ZIP CODE
		70 Oakley Road	Belmont	MA 02178

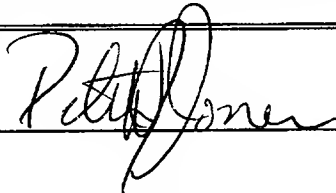
203	FULL NAME OF INVENTOR	LAST NAME	FIRST NAME	MIDDLE NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE OR COUNTRY AND ZIP CODE

203	FULL NAME OF INVENTOR	LAST NAME	FIRST NAME	MIDDLE NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE OR COUNTRY AND ZIP CODE

- 3 -

I hereby further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signature of Inventor 201



Date:

6/5/98

Signature of Inventor 202

Date:

Signature of Inventor 203

Date:

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) AND 1.27 (c)) - SMALL BUSINESS CONCERN			Docket No. 47513 (1106)
Serial No.	Filing Date Herewith	Patent No.	Issue Date
Applicant/ Peter W. J. Jones Patentee:			
Invention: METHODS FOR REFLECTION REDUCTIONS			
<p>I hereby declare that I am:</p> <p><input type="checkbox"/> the owner of the small business concern identified below:</p> <p><input checked="" type="checkbox"/> an official of the small business concern empowered to act on behalf of the concern identified below:</p> <p>NAME OF CONCERN: <u>TENEBRAEX CORPORATION</u></p> <p>ADDRESS OF CONCERN: <u>43 Charles Street, Boston, MA 02114 ONE KENDALL SQ CAMBRIDGE MA 02139</u></p> <p>I hereby declare that the above-identified small business concern qualifies as a small business concern as defined in 37 CFR 1.21.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.</p> <p><input checked="" type="checkbox"/> I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the above identified invention described in:</p> <p><input checked="" type="checkbox"/> the specification filed herewith with title as listed above.</p> <p><input type="checkbox"/> the application identified above.</p> <p><input type="checkbox"/> the patent identified above.</p> <p>If the rights held by the above-identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed on the next page and no rights to the invention are held by any person, other than the inventor, who could not qualify as an independent inventor under 37 CFR 1.9(c) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).</p>			

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

- ☒ no such person, concern or organization exists.
☐ each such person, concern or organization is listed below.

FULL NAME _____
ADDRESS _____

☐ Individual ☐ Small Business Concern ☐ Nonprofit Organization

FULL NAME _____
ADDRESS _____

☐ Individual ☐ Small Business Concern ☐ Nonprofit Organization

FULL NAME _____
ADDRESS _____

☐ Individual ☐ Small Business Concern ☐ Nonprofit Organization

FULL NAME _____
ADDRESS _____

☐ Individual ☐ Small Business Concern ☐ Nonprofit Organization

Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING: Peter W.J. Jones

TITLE OF PERSON SIGNING _____

OTHER THAN OWNER: President and CEO

ADDRESS OF PERSON SIGNING: 70 Oakley Road
Belmont, MA 02178

SIGNATURE: _____

DATE: 6/5/98